



July 14, 2017

**VIA ELECTRONIC FILING**

Ms. Marlene H. Dortch, Secretary  
Federal Communications Commission  
445 Twelfth Street, SW  
Washington, DC 20554

**Re: Ex Parte Presentation, Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14-177; IB Docket No. 15-256; RM-11664; WT Docket No. 10-112; IB Docket No. 97-95.**

Dear Ms. Dortch,

CTIA respectfully submits this filing to present a Roadmap for High Band Spectrum ("Roadmap") for the additional spectrum bands above 24 GHz that are the subject of the above-referenced proceedings.<sup>1</sup> As has been documented in the record, the U.S. wireless industry is in a global race to lead the world in the development of the next generation of wireless services, 5G. Access to licensed high band spectrum, which offers the potential for larger channel sizes, is key to this effort. With the right spectrum and infrastructure policies in place, the wireless industry is poised to invest \$275 billion over the next decade to deploy 5G; this is in addition to the \$200 billion already invested by the wireless industry since 2010.<sup>2</sup> In turn, the development and deployment of 5G will generate \$500 billion in economic growth, create three million new jobs, and enable breakthrough innovations in public safety, transportation, healthcare, energy, and other sectors of the U.S. economy.<sup>3</sup> Without significant new amounts of high band licensed spectrum available for exclusive terrestrial use,

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<sup>1</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016) ("*Spectrum Frontiers Order and FNPRM*").

<sup>2</sup> *Smart Cities: How 5G Can Help Municipalities Become Vibrant Smart Cities*, ACCENTURE STRATEGY (Jan. 2017), <https://www.ctia.org/docs/default-source/default-document-library/how-5g-can-help-municipalities-become-vibrant-smart-cities-accenture.pdf>.

<sup>3</sup> *Wireless Connectivity Fuels Industry Growth and Innovation in Energy, Health, Public Safety, and Transportation*, DELOITTE (Jan. 2017), [http://www.ctia.org/docs/default-source/default-documentlibrary/deloitte\\_20170119.pdf](http://www.ctia.org/docs/default-source/default-documentlibrary/deloitte_20170119.pdf).



the ability for the U.S. to continue to lead the world in mobile broadband innovation and investment will be jeopardized.

As an initial matter, the Commission should refrain from modifying the coordination framework between terrestrial licensees and satellite providers that governs the use of the millimeter wave spectrum bands. The compromise adopted by the Commission represents a balance between the need for rapid deployment of terrestrial 5G service and continued access for FSS earth stations on a flexible basis. There is no need for the Commission to revisit this coordination framework, which involved concessions from both affected industries.<sup>4</sup> Additionally, the Roadmap detailed herein will provide significant blocks of spectrum to facilitate 5G mobile broadband networks and services. Importantly, the Roadmap also provides a path for satellite interests seeking access to high band spectrum, in addition to that made available under the Commission's flexible framework adopted in the *Spectrum Frontiers Order*. The Roadmap thus presents a balanced approach that will enable innovation for both terrestrial mobile wireless and satellite to the ultimate benefit of consumers.

**Roadmap for High Band Spectrum.** To enable the development and deployment of 5G, the Commission should commit to making available at least 15 gigahertz of spectrum in large contiguous blocks for terrestrial licensed use. CTIA herein provides an approach that supplements the initial spectrum outlay (the 28 GHz and 37/39 GHz bands) with additional spectrum for future terrestrial and satellite use. Importantly, CTIA and its member companies have closely studied the existing spectrum allocations in the millimeter wave bands to develop a Roadmap that allows for terrestrial 5G services while still enabling Fixed-Satellite Service ("FSS") usage. In the attached Roadmap, CTIA offers a balanced approach for terrestrial and FSS systems, with approximately 20 gigahertz of spectrum available for each industry.

Specifically, the Commission should:

- Fulfill the promise of the *Spectrum Frontiers Order* by auctioning the Commission's inventory of spectrum in the 27.5-28.35 GHz ("28 GHz") and 37-40 GHz ("37/39 GHz") bands no later than December 31, 2018.
- Improve the *Spectrum Frontiers Order* by modifying the existing license scheme for the 37-37.6 GHz band and allowing for terrestrial licensed use of the 42-42.5 GHz ("42 GHz") band. The additional 500 megahertz of spectrum in the 42 GHz

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<sup>4</sup> See *Ex Parte* Presentation of CTIA, GN Docket No. 14-177, *et al*, at 2-4 (filed May 22, 2017).



band will be utilized along with the 37/39 GHz band to provide 3.5 gigahertz of spectrum that can be accommodated into a single radio in mobile devices.

- Create a nearly contiguous block of spectrum from 24 GHz to 28 GHz for licensed terrestrial services by permitting terrestrial mobile use of the 24.25-24.45 GHz and 24.75-25.25 GHz ("24 GHz") and the 25.25-27.5 GHz ("26 GHz") bands, in addition to the existing allocation at 28 GHz.
- Create a five-gigahertz, almost contiguous block of high band spectrum for mobile broadband by allowing for terrestrial licensed use of the 47.2-50.2 GHz ("47 GHz") and 50.4-52.6 GHz ("50 GHz") bands.
- Allow for mobile broadband use in the remaining Local Multipoint Distribution Service ("LMDS") spectrum bands at 29.1-29.25 GHz ("29 GHz") and 31-31.3 GHz ("31 GHz") that will enhance the other suggested allocations in the 24-28 GHz and the 31.8-33.4 GHz ("32 GHz") bands.
- Allow terrestrial licensed use of the 32 GHz band, while fully protecting radio astronomy ("RAS") use.
- Allow shared access to the 71-76 GHz band for terrestrial licensed and FSS under existing Part 30 rules.
- Provide additional opportunities for satellite industry deployment by permitting satellite feeder links in the 50.4-51.4 GHz segment of the band and considering the viability of the 81-86 GHz band for additional satellite uplinks to accommodate future satellite expansion.

**28 GHz and 37/39 GHz.** The initial "down payment" of high band spectrum for 5G is contained in the 28 GHz and 37/39 GHz bands. Almost 75 percent of the population is covered by existing licenses in these bands,<sup>5</sup> and wireless companies are moving aggressively to access these bands to begin 5G deployment. Further delay or uncertainty in these initial bands will stall 5G's economic engine just as it is getting started. The Commission should reaffirm its original terrestrial/satellite coordination framework for these spectrum bands,<sup>6</sup> while simultaneously adjusting the sharing requirements in the 37-37.6 GHz band to allow for exclusive use with sharing between federal and non-federal users on a coordinated basis.<sup>7</sup> Assuming the Commission resolves these outstanding issues in 2017, it should move to hold an auction for these spectrum bands no later than December 31, 2018.

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<sup>5</sup> *Spectrum Frontiers Order and FNPRM* ¶ 19.

<sup>6</sup> CTIA Opposition of Petitions for Reconsideration, GN Docket No. 14-177, *et al.*, at 4-11 (filed Jan. 31, 2017).

<sup>7</sup> CTIA Reply to Oppositions, GN Docket No. 14-177, *et al.*, at 8-10 (filed Feb. 24, 2017).



**24 GHz and 26 GHz.** To create a nearly contiguous four gigahertz block of spectrum from 24.25 to 28.35 GHz, the Commission should allow for mobile terrestrial use of the 24 GHz and the 26 GHz bands. The 24 GHz band was previously licensed for terrestrial use and was limited to fixed operations, but has an existing mobile allocation for terrestrial services.<sup>8</sup> In addition, the Commission should examine the use of the 26 GHz band, which, along with the 24 GHz and 28 GHz bands, could result in more than four gigahertz of nearly contiguous spectrum between 24.25-28.35 GHz. Terrestrial mobile use of the 26 GHz band has support in the record<sup>9</sup> and internationally,<sup>10</sup> and it can further grow the 28 GHz band, which is already exhibiting its value for 5G.<sup>11</sup> Furthermore, incorporating the 26 GHz band into the 28 GHz ecosystem will allow technical efficiencies and leverage the rapidly developing 28 GHz equipment market.<sup>12</sup>

**42 GHz.** In addition to the 37/39 GHz band that the Commission already allocated for terrestrial use and for which it adopted service rules, the Commission also proposes in the *Spectrum Frontiers Order and FNPRM* to authorize fixed and mobile service operations in the 42 GHz band under Part 30 rules.<sup>13</sup> CTIA supports this proposal and urges the Commission to

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<sup>8</sup> See 47 C.F.R. § 2.106.

<sup>9</sup> See Comments of T-Mobile USA, Inc., GN Docket No. 14-177, *et al.*, at 6 (filed Sept. 30, 2016) (“T-Mobile Comments”); see also Comments of the Information Technology Industry Council, GN Docket No. 14-177, *et al.*, at 7 (filed Jan. 27, 2016).

<sup>10</sup> The 26 GHz band is among the bands designated for study for mobile use at WRC-15. See WORLD RADIOCOMMUNICATION CONFERENCE (WRC-15), Final Acts, at 298 (2016), <http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.297.43.en.100.pdf>

<sup>11</sup> Thomas Gryta and Drew FitzGerald, *Verizon Wins Bidding War for Straight Path Communications*, WALL ST. J. (May 11, 2017), <https://www.wsj.com/articles/verizon-wins-bidding-war-for-straight-path-communications-sources-say-1494470230>; Bob Bryan, *A communications company caught in a bidding war between Verizon and AT&T has seen its stock explode over 500% in 3 months*, BUSINESS INSIDER (May 8, 2017), <http://www.businessinsider.com/verizon-att-bidding-war-for-straight-path-communications-5g-network-2017-5>; Liana B. Baker, *Verizon's bid challenges AT&T's offer for Straight Path*, REUTERS (Apr. 25, 2017), <http://www.reuters.com/article/us-straight-path-m-a-at-t-idUSKBN17R19L>.

<sup>12</sup> See Comments of Ericsson, GN Docket No. 14-177, *et al.*, at 11-12 (filed Sept.30, 2016) (“Ericsson Comments”).

<sup>13</sup> *Spectrum Frontiers Order and FNPRM* ¶ 403.



make the band available for terrestrial licensed uses.<sup>14</sup> This spectrum band has a primary fixed and mobile terrestrial allocation and is among the spectrum bands being studied internationally for future 5G services.<sup>15</sup> Radio manufacturers should be able to incorporate this 500 megahertz of spectrum into a single radio that encompasses this band as well as the 37/39 GHz band.<sup>16</sup>

**47 GHz and 50 GHz.** As proposed in the *Spectrum Frontiers Order and FNPRM*, the Commission should authorize fixed and mobile use of the 47 GHz and 50 GHz bands.<sup>17</sup> Both bands are being studied internationally for mobile use<sup>18</sup> and, together, could potentially provide 5.2 gigahertz of spectrum for 5G.<sup>19</sup> Allocating a large portion of this band for satellite uplink, as proposed by Boeing,<sup>20</sup> could greatly limit the utility of the band for terrestrial services and should be rejected.<sup>21</sup> Instead, the Commission should maintain the careful balance it struck between terrestrial and satellite interests in the *Spectrum Frontiers Order* and permit only satellite feeder links in the 50.4-51.4 GHz segment of the band, to the extent that it does not interfere with terrestrial use.

If, however, the Commission determines that future satellite expansion requires additional spectrum for satellite uplinks, it should look first to the large, unused FSS satellite

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<sup>14</sup> See Comments of CTIA, GN Docket No. 14-177, *et al.*, at 13 (filed Sept. 30, 2016) ("CTIA Comments"); Reply Comments of CTIA, GN Docket No. 14-177, *et al.*, at 4 (filed Oct. 31, 2016) ("CTIA Reply Comments"); T-Mobile Comments at 4; Reply Comments of T-Mobile USA, Inc. GN Docket No. 14-177, *et al.*, at 10 (filed Oct. 31, 2016) ("T-Mobile Reply Comments").

<sup>15</sup> WORLD RADIOCOMMUNICATION CONFERENCE (WRC-15), Final Acts, at 298 (2016), <http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.297.43.en.100.pdf>.

<sup>16</sup> Ericsson Comments at 11-12.

<sup>17</sup> See *Spectrum Frontiers Order and FNPRM* ¶¶ 410-420.

<sup>18</sup> WORLD RADIOCOMMUNICATION CONFERENCE (WRC-15), Final Acts, at 298 (2016), <http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.297.43.en.100.pdf>

<sup>19</sup> Currently, the 50.2-50.4 GHz band is allocated internationally for passive services for weather prediction and disaster management. CTIA agrees with commenters that these passive services can be protected through exclusion zones, interference coordination, and aggregate emissions limits. See also T-Mobile Comments at 12-13. The Commission should seek further comment on the potential use and necessary parameters of the above-mentioned protection to facilitate the creation of a contiguous band while protecting passive services.

<sup>20</sup> Comments of The Boeing Company, GN Docket No. 14-177, *et al.*, at 28 (filed Sept. 30, 2016).

<sup>21</sup> See e.g., T-Mobile Reply Comments at 18-19.



uplink allocation in the 81-86 GHz band.<sup>22</sup> Providing uplink in the 81-86 GHz band would make efficient use of an underutilized band and more than satisfy the uplink needs of the satellite industry.

This alternative is workable for several reasons. First, the free space path loss of signals in the 81-86 GHz band is comparable to that of much lower bands and better than the path loss in the 50.4-52.4 GHz bands.<sup>23</sup> Second, the 81-86 GHz band would provide the five gigahertz of uplink spectrum that the satellite industry claims is essential to the next generation of satellite networks.<sup>24</sup> Third, unlike the 47.2-50.2 GHz, 50.4-51.4 GHz, and 51.4-52.4 GHz bands that the satellite industry hopes to cobble into a suitable uplink, the 81-86 GHz band would be contiguous, avoid adjacent-channel interference to the earth exploration satellite services between 50.2 GHz and 50.4 GHz, and obviate the need to share with the terrestrial operations that the Commission already proposed for the 47 GHz band. Fourth, because of its shorter wavelengths, the 81-86 GHz band permits the use of smaller antennas than would be required for similar uses in lower bands, thereby opening up opportunities for dynamic new use cases.<sup>25</sup> An ability to use a smaller antenna would allow FSS providers to utilize smaller user station devices or to more easily place a significantly greater number of antennas into user equipment enabling better service and data rates.<sup>26</sup> Finally, the 81-86 GHz

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<sup>22</sup> This band is allocated to the fixed, fixed-satellite (Earth-to-space), mobile, and radio astronomy services on a primary basis. The 81-84 GHz band has an additional allocation for the mobile-satellite service (Earth-to-space) on a primary basis and to the space research service (space-to-Earth) on a secondary basis. See 47 C.F.R. § 2.106.

<sup>23</sup> See e.g., Ted Rappaport, Professor, NYU Polytechnic School of Engineering, *Millimeter Wave Cellular Communications: Channel Model, Capacity Limits, Challenges and Opportunities*, Presentation to IEEE Comm. Theory Workshop, at 4 (May 26, 2014) (demonstrating the attenuation of different millimeter wave bands).

<sup>24</sup> See e.g., Comments of the Satellite Industry Association, GN Docket No. 14-177, *et al.*, at 5-6 (filed Oct. 17, 2016).

<sup>25</sup> The higher the frequency used for transmissions, the smaller the wavelength of the signal (in other words, wavelength is inversely proportional to frequency). For an antenna in a radio system to receive a signal in the most efficient manner, the antenna size should be of the same physical size as the wavelength of the signal. See, e.g., Bill Schweber, *Understanding Antenna Specifications and Operation, Part 1*, DIGI-KEY ELECTRONICS (Apr. 12, 2017), <https://www.digikey.com/en/articles/techzone/2017/apr/understanding-antenna-specifications-and-operation> ("The equation clearly shows that the higher the frequency, the shorter the wavelength, and the smaller the antenna.").

<sup>26</sup> See, e.g., *Many antennas, multiple benefits: Can handle cellular traffic more reliably*, SCIENCEDAILY (Jan. 20, 2015), <https://www.sciencedaily.com/releases/2015/01/150120084543.htm>.



band is already subject to database requirements<sup>27</sup> that the satellite industry has urged to enable sharing<sup>28</sup> – making it an excellent candidate for use for FSS (while grandfathering the existing terrestrial fixed uses of the band that are subject to the database requirement).

**29 GHz and 31 GHz.** The Commission already adopted Part 30 service rules for the 28 GHz LMDS band and should also do so for the remaining LMDS bands (29 GHz and 31 GHz). In the *Spectrum Frontiers NPRM*, the Commission declined to propose authorizing mobile operation in the 29 GHz and 31 GHz bands because they offered less than the 500 megahertz of contiguous spectrum that some commenters suggested might be necessary for mobile operations.<sup>29</sup> However, these two bands are generally lower in frequency than many of the other bands proposed for Part 30 uses and will, therefore, propagate better than higher millimeter wave frequencies.<sup>30</sup> The remaining LMDS bands, if operating under consistent rules,<sup>31</sup> and when combined with the already available 28 GHz band, could be efficiently managed by an integrated radio to leverage economies of scale to provide 3.8 gigahertz of spectrum in total.<sup>32</sup> The Commission should seize the opportunity to use the technological potential of an integrated radio to make more efficient use of valuable spectrum that will

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<sup>27</sup> See 47 C.F.R. § 101.1523; see also *Wireless Telecommunications Bureau Announces Permanent Process for Registering Links in the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands*, Public Notice, 20 FCC Rcd 2261 (2005) (identifying the third-party database providers managing these spectrum bands).

<sup>28</sup> See, e.g., *Ex Parte* Presentation of EchoStar Satellite Operating Corporation, *et al.*, GN Docket No. 14-177, *et al.*, at 6 (filed May 5, 2017) (“Apply the 70/80/90 GHz Band Database Approach to UMFUS Facilities.”).

<sup>29</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Notice of Proposed Rulemaking, 30 FCC Rcd 11878, ¶ 70 (2015) (“*Spectrum Frontiers NPRM*”). CTIA recognizes that, because the Commission declined to propose authorizing mobile operations in this band in the *Spectrum Frontiers NPRM*, any decision to authorize mobile operations will require proper notice and comment.

<sup>30</sup> Comments of Nextlink Wireless, LLC, GN Docket No. 14-177, *et al.*, at 4 (filed Sep. 30, 2016).

<sup>31</sup> See CTIA Reply Comments at 4.

<sup>32</sup> Comments of Ericsson Inc., GN Docket No. 14-177, *et al.*, at 37 (filed Jan. 15, 2015) (stating that “[t]he entire band from 27.5 to 31.3 GHz can probably be handled by an integrated radio depending on coexistence requirements for existing primary services,” meaning that device manufacturers can build equipment capable of using the entire LMDS band at marginal additional cost).



otherwise be stranded once incumbent licensees replace their existing operations with new 5G operations under Part 30.<sup>33</sup>

**32 GHz.** As proposed in the *Spectrum Frontiers Order and FNPRM*, the Commission should make the 32 GHz band available for licensed, exclusive-use, terrestrial operations by adding primary, non-federal, fixed and mobile service allocations to the band under the Part 30 rules.<sup>34</sup> The WRC-15's decision to conduct sharing and compatibility studies for the band, the potential for mobile allocation at WRC-19, possible global harmonization, and the strong support in the record all weigh heavily in favor of the Commission moving forward with its proposal.<sup>35</sup> Opening the 32 GHz band for 5G could create significant utility for what is currently a very valuable but underused band.

Furthermore, shared use between 5G and hypothesized radionavigation in the 32.3-33.4 GHz portion of the band is possible and supported by the record.<sup>36</sup> Also, as commenters have noted, using geographic separation, terrain, and network capabilities, licensees in this band could ensure protection of the handful of remote RAS locations in the adjacent 31.3-31.8 GHz band.<sup>37</sup>

**70 GHz.** The 71-76 GHz band has existing primary allocations for both terrestrial (mobile and fixed) as well as FSS for downlinks. As this allocation pattern is consistent with the 37/39 GHz band, CTIA suggests that the Commission license the 71-76 GHz band for terrestrial services, while allowing FSS utilization of the band under the same Part 30 criteria as were adopted for the 37/39 GHz band. This will provide an additional five gigahertz of contiguous

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<sup>33</sup> Comments of Verizon, GN Docket No. 14-177, *et al.*, at 5 (filed Sept. 30, 2016).

<sup>34</sup> *Spectrum Frontiers Order and FNPRM* ¶ 389.

<sup>35</sup> *Id.*

<sup>36</sup> See T-Mobile Reply Comments at 24; see also Comments of the Telecommunications Industry Association, GN Docket No. 14-177, *et al.*, at 9 (filed Sep. 30, 2016) (noting that “[c]urrently, there are no non-Federal licensees in the band despite an existing allocation for non-Federal radionavigation service”).

<sup>37</sup> See, e.g., T-Mobile Reply Comments at 24; see also Comments of NCTA – The Internet & Television Association, GN Docket No. 14-177, *et al.*, at 14 (filed Sept. 30, 2016) (“The sophisticated mitigation techniques that exist today, or those currently under development, could serve as a starting point for addressing coexistence between new 32 GHz mobile licensees and incumbent users.”).



spectrum for mobile broadband services, while also providing supplementary spectrum for FSS downlinks.

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The *Spectrum Frontiers* proceeding was initiated to facilitate the development and deployment of the next generation of wireless technology and to enable the U.S. to lead those efforts worldwide.<sup>38</sup> In doing so, the Commission recognized that the proceeding was driven by new technological breakthroughs that had dramatically changed the potential uses of spectrum bands above 24 GHz and transformed bands once suited to satellite or fixed microwave into bands capable of far more.<sup>39</sup>

If the Commission's objective is to "help ensure continued American leadership in wireless broadband by facilitating access to spectrum, maximizing flexibility, and encouraging wireless innovation"<sup>40</sup> the Roadmap detailed herein will make that objective a reality. The wireless industry is ready to invest and innovate in these new bands and, with the Commission's help, we will forge a new path for America.

Pursuant to Section 1.1206 of the Commission's rules, a copy of this letter is being filed in ECFS. Please do not hesitate to contact the undersigned with any questions.

Sincerely,

/s/ Scott K. Bergmann

Scott K. Bergmann  
Vice President, Regulatory Affairs  
CTIA

Attachment

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<sup>38</sup> *Spectrum Frontiers Order and FNPRM* ¶ 1 ("Today, we take a significant step towards securing the Nation's future in the next generational evolution of wireless technology to so-called 5G.").

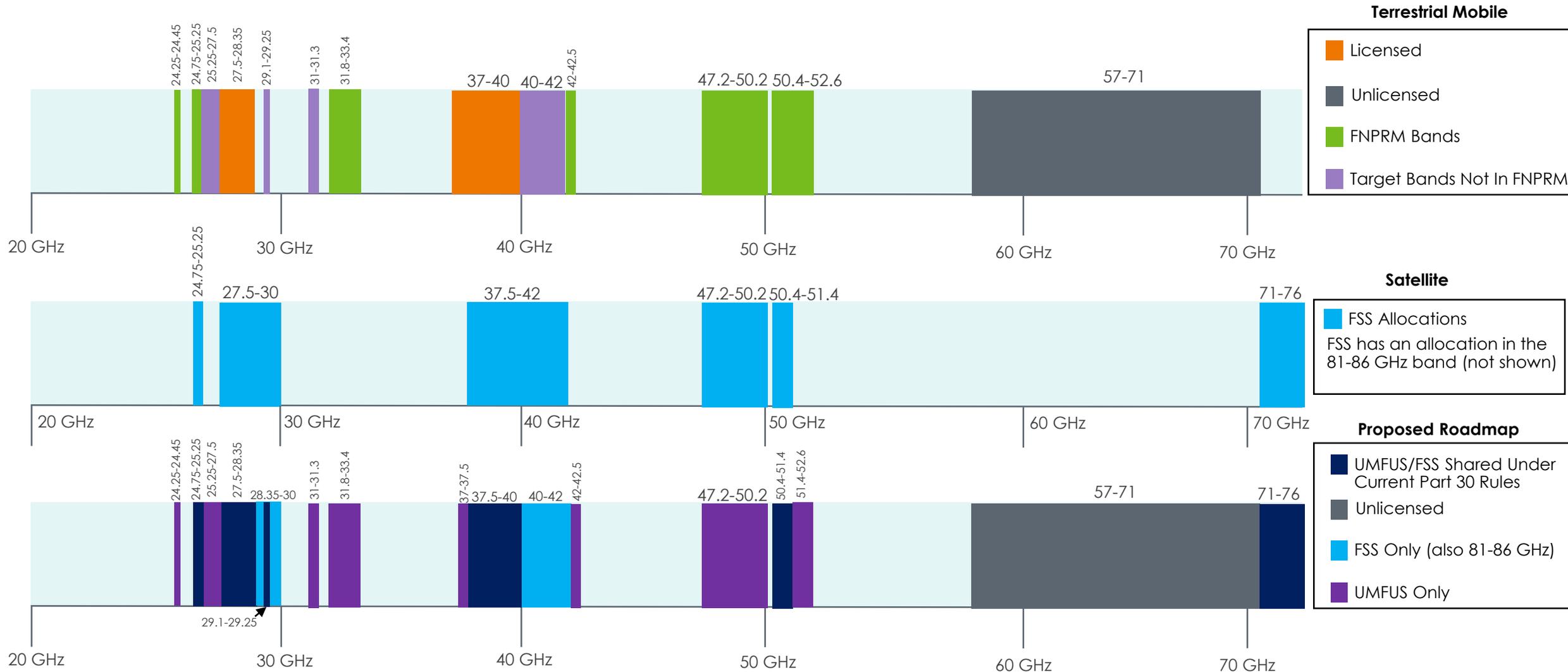
<sup>39</sup> *Id.* ("These high frequencies previously have been best suited for satellite or fixed microwave applications; however, recent technological breakthroughs have newly enabled advanced mobile services in these bands.").

<sup>40</sup> *Id.* ¶ 3.

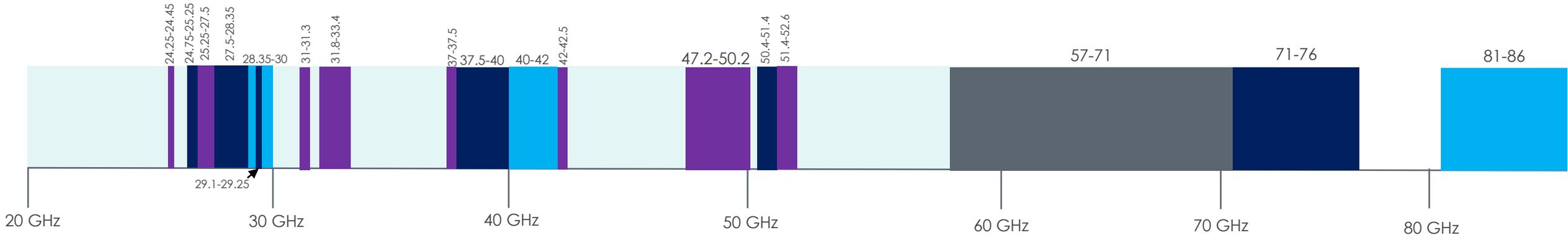


# **ATTACHMENT**

# Spectrum Frontiers Roadmap



# Spectrum Frontiers Roadmap



## Roadmap Overview

- At least 15 gigahertz of terrestrial licensed spectrum in large contiguous blocks.
- Existing Part 30 sharing rules should be maintained for the 28 GHz (27.5-28.35 GHz) and 37 GHz (37-40 GHz) bands.
- 37-37.6 GHz should be available for exclusive use with sharing requirements solely for Federal users.
- 24.25-28.35 GHz available for nearly contiguous use by licensed terrestrial systems.
- 40-42 GHz allocated solely to FSS downlinks; 42-42.5 GHz available for licensed terrestrial use.
- 47.2-50.2 GHz should be solely for licensed terrestrial use.
- 50.4-51.4 GHz can be shared between FSS and terrestrial under current Part 30 rules.
- 71-76 GHz shared between FSS and terrestrial under current Part 30 rules.
- 81-86 GHz dedicated to FSS uplink use, with grandfathered use for terrestrial.

## FSS Allocation

- 19.75 GHz Total for FSS
- 10.25 GHz for uplinks
  - 24.75-25.05 GHz
  - 27.5-30 GHz
  - 50.4-51.4 GHz
  - 81-86 GHz
- 9.5 GHz for downlinks
  - 37.5-42 GHz
  - 71-76 GHz
- 8.5 GHz exclusive for FSS
  - 28.35-29.1 GHz
  - 29.25-30 GHz
  - 40-42 GHz
  - 81-86 GHz

## Terrestrial Allocation

- 19.55 GHz Total for Terrestrial
  - 24.25-24.45 GHz
  - 24.75-28.35 GHz\*
  - 29.1-29.25 GHz
  - 31-31.3 GHz
  - 31.8-33.4 GHz
  - 37-40 GHz
  - 42-42.5 GHz
  - 47.2-50.2 GHz
  - 50.4-52.6 GHz
  - 71-76 GHz
- 9.45 GHz exclusive for Terrestrial
  - 24.25-24.45 GHz
  - 25.25-27.5 GHz\*
  - 31-31.3 GHz
  - 31.8-33.4 GHz
  - 37-37.5 GHz
  - 42-42.5 GHz
  - 47.2-50.2 GHz
  - 51.4-52.6 GHz

## Proposed Roadmap

- UMFUS/FSS Shared Under Current Part 30 Rules
- Unlicensed
- FSS Only
- UMFUS Only

\*The 25.25-27.5 GHz band will require a future allocation and proceeding